Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **October/November 2025**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You will be allowed to work with the apparatus for a maximum of 1 hour for each question.
- You should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
1	
2	
Total	

This document has **12** pages.

[Turn over

You may not need to use all of the materials provided.

1 In this experiment, you will investigate oscillations.

You have been provided with a double spring and two single springs.

(a) (i) • Slide the double spring and the two single springs onto the longer wooden rod.

• Set up the apparatus as shown in Fig. 1.1.

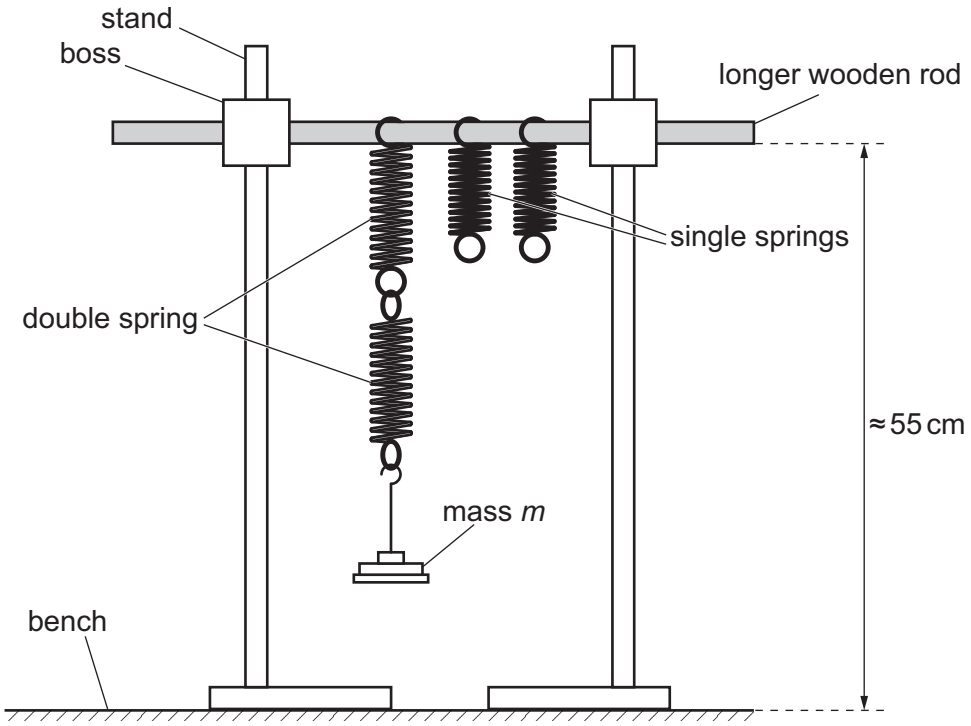


Fig. 1.1

• Use the bosses to fix the wooden rod approximately 55 cm above the bench and parallel to the bench.

• Hang a total mass of 270 g from the double spring.

• The mass hanging from the double spring is *m*.

Record *m*.

m = ... [1]

(ii) • Gently pull the mass down through a short distance. When released, the mass will oscillate.

• Take measurements to determine the period T_1 of the oscillations.

T_1 = ...

• Remove the mass from the double spring.

[2]

(b) • Using the shorter wooden rod, hang mass *m* as shown in Fig. 1.2.

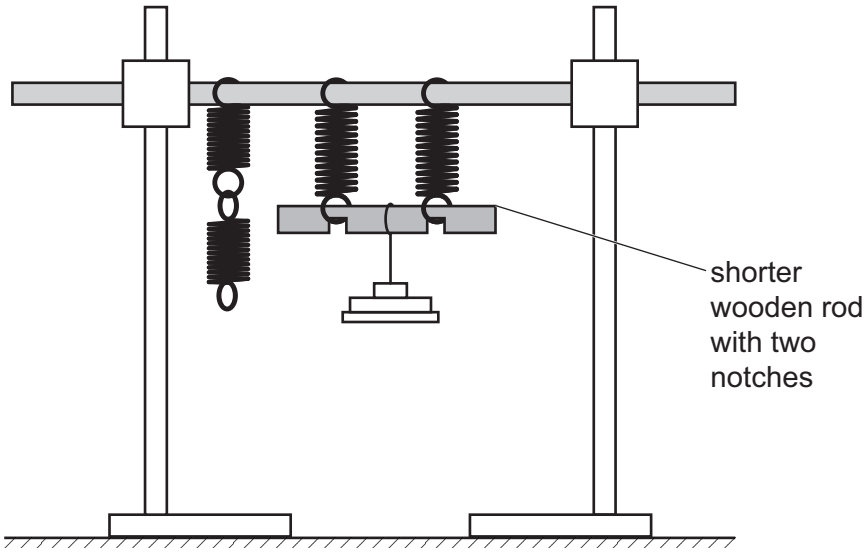


Fig. 1.2

• **Gently** place the hook of the mass hanger near the centre of the shorter rod.

• **Carefully** adjust the position of the mass hanger until the shorter rod is approximately parallel to the bench, as shown in Fig. 1.2.

• Gently pull the mass down through a short distance. When released, the mass will oscillate.

• Take measurements to determine the period T_2 of the oscillations.

T_2 = ...

• Remove the mass.

[1]

(c) Vary m. For each value of m, determine T_1 and T_2. Repeat until you have five sets of values of m, T_1 and T_2. Do **not** use values of m less than 200 g.

Record your results in a table. Include values of $\sqrt{T_1}$ and $\sqrt{T_2}$ in your table.

[8]

(d) (i) Plot a graph of $\sqrt{T_2}$ on the y-axis against $\sqrt{T_1}$ on the x-axis. [3]

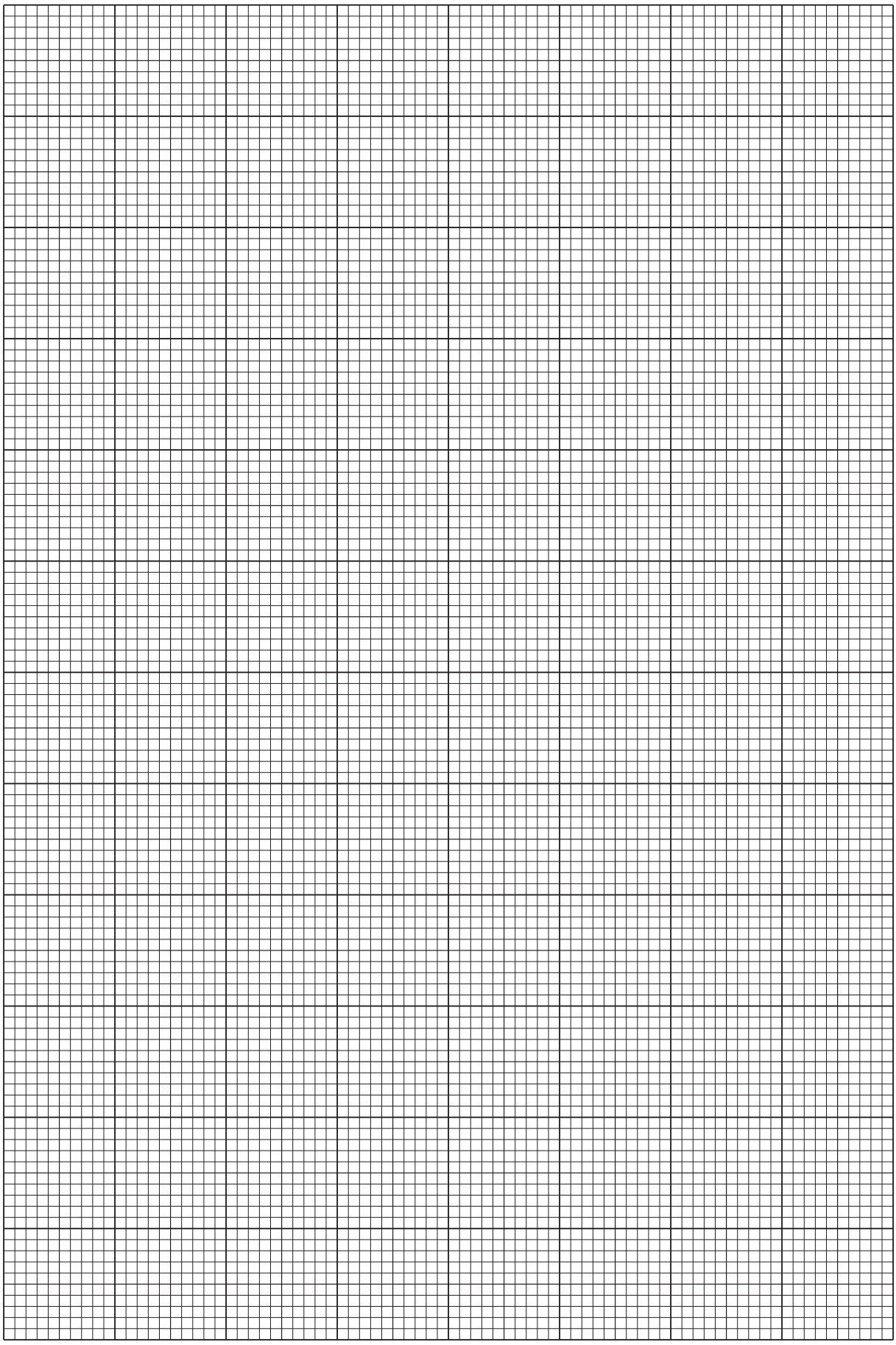
(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities $\sqrt{T_2}$ and $\sqrt{T_1}$ are related by the equation

$$\sqrt{T_2} = P\sqrt{T_1} + Q$$

where P and Q are constants.

Using your answers in **(d)(iii)**, determine the values of P and Q.
Give appropriate units.

P = ...

Q = ...
[2]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the deformation of paper cylinders.

(a) You have been provided with two pieces of paper.

The width of a piece of paper is the length *w* of the shorter side, as shown in Fig. 2.1.

Fig. 2.1

- Select the **smaller** piece of paper.
- Measure and record *w*.

w = ... cm

- Roll the paper into a cylinder and use two paper clips to hold the paper in place, as shown in Fig. 2.2.

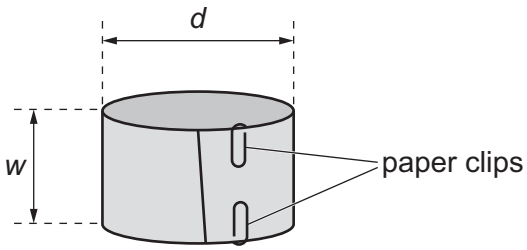


Fig. 2.2

- The diameter of the cylinder is *d*, as shown in Fig. 2.2.

  Adjust the paper and paper clips until *d* is as close as possible to 7.0 cm.

- Measure and record *d*.

d = ... cm
[2]

(b) (i) • Set up the apparatus as shown in Fig. 2.3.

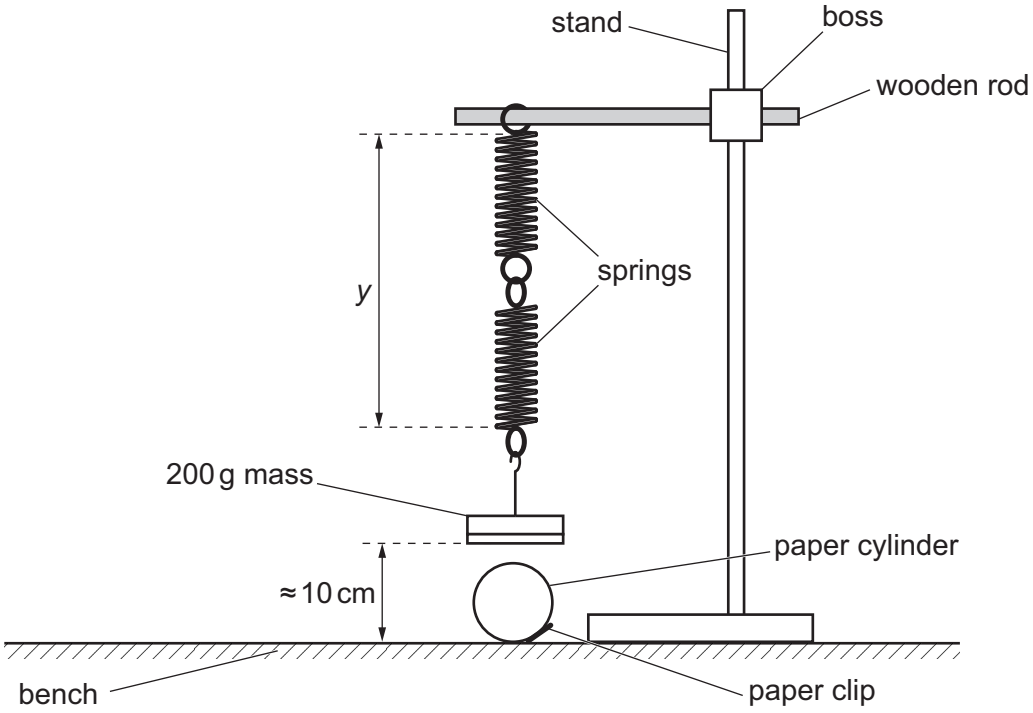


Fig. 2.3

- Slide the loop of the upper spring onto the wooden rod.
- Hang a mass of 200 g from the lower spring.
- Adjust the height of the boss until the bottom of the mass is approximately 10 cm above the bench.
- Place the paper cylinder so that the middle of the cylinder is under the mass, as shown in Fig. 2.3.
- The length of the springs is *y*, as shown in Fig. 2.3.

  Measure and record *y*.

y = ... cm [1]

(ii) Estimate the percentage uncertainty in your value of y. Show your working.

percentage uncertainty = ...% [1]

(c) (i) • By adjusting the height of the boss, lower the mass to squash the middle of the paper cylinder until the bottom of the mass is 2.5 cm above the bench, as shown in Fig. 2.4.

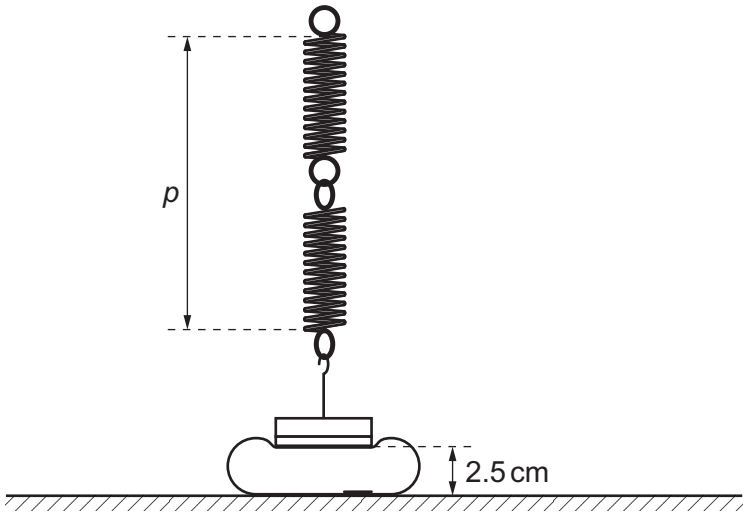


Fig. 2.4 (not to scale)

• The length of the springs is p, as shown in Fig. 2.4.

Measure and record p.

p = ... cm [1]

(ii) Calculate $(y - p)$.

$(y - p)$ = ... cm [1]

(d) Using the **larger** sheet of paper, repeat **(a)**, **(b)(i)**, **(c)(i)** and **(c)(ii)**.

w = ... cm

d = ... cm

y = ... cm

p = ... cm

$(y - p)$ = ... cm
[3]

(e) It is suggested that the relationship between w, y and p is

$$w = k(y - p)$$

where k is a constant.

(i) Using your data, calculate **two** values of k.

first value of k = ...

second value of k = ...
[1]

(ii) Justify the number of significant figures that you have given for your values of k.

.....

.....

..... [1]

(f) It is suggested that the percentage uncertainty in the values of k is 10%.

Using this uncertainty, explain whether your results support the relationship in **(e)**.

.....

.....

.....

..... [1]

(g) (i) Describe **four** sources of uncertainty or limitations of the procedure for this experiment.

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

(ii) Describe **four** improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

[Total: 20]